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The Numerical Lunar Theory. By Sir G. B. Airy, K.C.B.

(*Extract from a letter to Mr. Knobel.*)

You will remember that some months ago I stated to you that I had discovered an important error in my Lunar theory (the use of one large term only, where I ought to have used two). I have satisfied myself that I cannot remedy this without a greater amount of labour than I am able to give to it at present. From yourself, and from the Royal Astronomical Society, I have received every mark of sympathy with my exertions, and I therefore deem it my duty, at whatever pain to myself, to state to you, and through you to the Royal Astronomical Society and to the scientific world, the failure of my enterprise. It would be useless now to attempt any more detailed explanation of the cause of this failure.

I keep up my attention to the general subject, but with my advanced age (eighty-eight) and failing strength, I can scarcely hope to bring it to a satisfactory conclusion. I will only further remark that I believe the plan of action which I had taken up would, if properly used, have led to a comparatively easy process, and might in that respect be considered as not destitute of all value. . . .

The White House, Greenwich:
1888, *October* 10.

Results of Recent Investigations of Stellar Parallax, made at the University Observatory, Oxford. By the Rev. Professor Pritchard, D.D., F.R.S.

It may be interesting to the Society to be informed respecting the present condition of the work on Stellar Parallax by means of the photographic process, which I have already described in previous communications.

The scheme adopted aims at obtaining in the first instance the "parallax," in the sense in which that term is generally understood, of those stars of the second magnitude which have a suitable declination for observation at Oxford. The parallaxes of those of the first magnitude have already been derived by various astronomers, and very recently have been the subject of investigation by Dr. Elkin with the heliometer.* Such a scheme, if carried out with perseverance and success, cannot fail to contribute in a sensible degree towards our knowledge of what Herschel called the "construction of the heavens."

The results of the application of the method to the two stars constituting 61 *Cygni* have been given in a previous communica-

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* Report for the year 1887–8 of the Board of Managers of the Observatory of Yale University.

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tion. The same process has been more recently applied here to *μ Cassiopeiæ* and *Polaris.* Inasmuch as the process is novel, the whole detail of the work will be published *in extenso*, under the auspices of the Board of Visitors of the Oxford University Observatory. The fasciculus in which these details will be given is very nearly completed for the press.

Besides the parallaxes of these four stars, which in all respects are complete, a provisional determination has been arrived at for *α*, *β*, and *γ Cassiopeiæ.* Further, the necessary photographic plates have been secured for completing the investigation of the parallaxes of *α Cephei* and of *γ* and *ε Cygni.* To these should be added *α Coronæ*, *α* and *β Andromedæ*, making altogether, and including the four stars already mentioned, thirteen stars, the discussion of the parallax of which will be immediately proceeded with, and carried on concurrently with the observation of another batch of second-magnitude stars. I now enumerate these details mainly for the purpose of indicating the capacity of the new method, and the advance already made in its application. If persevered in, it is expected that the parallaxes of about twelve additional stars will be annually added to our present knowledge of this subject, and this I apprehend is the limit of work to be anticipated from the exertions of a single observer, with a single instrument in this climate.

Table showing the Parallaxes of Stars recently determined at the University Observatory, Oxford.

Stars of Comparison.	Magnitude of Comparison Stars.	Differential Parallax.	Probable Error of Result.	Parallax from other Authorities.	
		μ Cassiopeiæ.			
D.M. 54° No. 225	7·7	0″·0211	0″·023	Bessel	−0″·12
„ 54 „ 217	9·2	0·0501	0·027	Struve	+0·342
		Polaris.			
D.M. 88 No. 4	6·7	0·0429	0·015	Lindenau	0·144
„ 88 „ 2	8·3	0·0758	0·014	Struve & Peters	0·172
„ 88 „ 9	8·4	0·0623	0·016	C. A. F. Peters	0·067
„ 88 „ 10	9·6	0·0992	0·013		
		α Cassiopeiæ.			
D.M. 55 No. 142	8·7	0·0748	0·024		
„ 55 „ 128	9·5	0·0678	0·055		
		β Cassiopeiæ.			
D.M. 58 No. 8	8·6	0·1759	0·047		
„ 58 „ 2700	8·8	0·1484	0·056		
		γ Cassiopeiæ.			
D.M. 59 No. 137	8·8	−0·014	0·047		
„ 59 „ 150	8·9	+0·007	0·042		

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An examination of the table shows that the Oxford results of some of these stars differ sensibly from those of other observers, who likewise differ greatly *inter se*. Guided by the suggestions of recent experience, I now think that such differences of "parallax" might very reasonably have been anticipated, and may properly be accepted as matters of fact, without in any degree impugning the accuracy of the observations. For in process of this work on parallax, and also from the general history of similar inquiries, it has been made abundantly evident that no necessary connection exists between the brightness of a star and its position in space or distance from the Sun. Nevertheless it is this very difference of brightness mainly which guides us in the selection of comparison stars. The "Parallax" is, in fact, and is becoming more and more generally recognised to be, a differential quantity, fainter stars being in very many instances much nearer to us than others possessing incomparably greater brightness. In passing, I may here instance α *Lyræ* as compared with 61 *Cygni*; β *Centauri* as compared with ε *Indi*.* In fact, the position in space of the faint comparison stars in relation to that of the star whose parallax is sought is, if not a matter of accident, at all events wholly unknown until the observations and computations are complete.

The case of *Polaris* in relation to the four comparison stars employed is somewhat remarkable, and I must in candour admit is not apparently in entire accordance with the preceding remark. The differential parallaxes of *Polaris* in relation to these four stars are more or less proportionate to the difference of brightness of *Polaris* and these stars. This difference of parallax so much exceeds the probable error of determination, that I propose to further pursue this somewhat novel and interesting question, by investigating the differential parallax of the comparison stars themselves with the aid of the new photographic refractor, now all but complete, at Oxford.

If these remarks be founded on fact, then any such term as "The mean Parallax" of a group of stars having the same magnitude possesses little or no scientific value, in the sense of its necessarily leading to the slightest knowledge of the parallax of any particular star in that group. In my view of the case, wherever the individual differences are so enormous, there an average of the whole is apt to be misleading and unscientific.

Possibly the researches already made, or being made, by the aid of the spectroscope may in due time lead to some natural classification of stars apart from that of magnitude or brightness. Such a classification, if it can be made, will in no degree detract from the value or dispense with the necessity of parallactic determinations.

Oxford University Observatory:
1888, *November* 8.

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* Heliometer-determinations of stellar parallax in the southern hemisphere, by Drs. Gill and Elkin.